

CLAIM AMENDMENTS

1     1.     (Previously Presented) A method of determining a placement of services of a  
2     distributed application onto nodes of a distributed resource infrastructure  
3     comprising the steps of:  
4         forming communication constraints between node pairs which ensure that  
5         a sum of transport demands between a particular node pair does not exceed a  
6         transport capacity between the particular node pair, each term of the sum  
7         comprising a product of a first placement variable, a second placement  
8         variable, and the transport demand between the services associated with the  
9         first and second placement variables;  
10        forming an objective; and  
11        employing a local search solution to solve an integer program comprising  
12        the communication constraints and the objective, which determines the  
13        placement of the services onto the nodes.

1     2.     (Previously Presented) A method of determining a placement of services of a  
2     distributed application onto nodes of a distributed resource infrastructure  
3     comprising the steps of:  
4         establishing an application model of the services comprising transport  
5         demands between the services;  
6         establishing an infrastructure model of the nodes comprising transport  
7         capacities between the nodes;  
8         forming an integer program that comprises:  
9             a set of placement variables for a combination of the services and the  
10            nodes, each of the placement variables indicating whether a particular  
11            service is located on a particular node;  
12            communication constraints between node pairs which ensure that a  
13            sum of the transport demands between a particular node pair does not  
14            exceed the transport capacity between the particular node pair, each term  
15            of the sum comprising a product of a first placement variable, a second  
16            placement variable, and the transport demand between the services  
17            associated with the first and second placement variables; and  
18            an objective; and

19                employing a local search solution to solve the integer program which  
20                determines the placement of the services onto the nodes.

1     3.        (Canceled)

1     4.        (Original) The method of claim 2 wherein the objective comprises  
2                minimizing communication traffic between the nodes.

1     5.        (Original) The method of claim 2 wherein the application model further  
2                comprises processing demands for the services.

1     6.        (Original) The method of claim 5 wherein the infrastructure model further  
2                comprises processing capacities for the nodes.

1     7.        (Original) The method of claim 6 wherein the integer program further  
2                comprises processing constraints which ensure that a sum of the processing  
3                demands for each of the nodes does not exceed the processing capacity for the  
4                node.

1     8.        (Original) The method of claim 7 wherein the objective comprises  
2                minimizing communication traffic between the nodes and balancing the  
3                processing demands on the nodes.

1     9.        (Original) The method of claim 6 wherein the processing demands and the  
2                processing capacities are normalized according to a processing criterion.

1     10.       (Original) The method of claim 9 wherein the processing criterion comprises  
2                an algorithm speed.

1     11.       (Original) The method of claim 9 wherein the processing criterion comprises  
2                a transaction speed.

1     12.       (Original) The method of claim 9 wherein the processing capacities of the  
2                nodes are found according to a look-up table in which different types of nodes

3 have been normalized according to the processing criterion.

1 13. (Original) The method of claim 2 wherein the application model further  
2 comprises storage demands for the services.

1 14. (Original) The method of claim 13 wherein the infrastructure model further  
2 comprises storage capacities for the nodes.

1 15. (Original) The method of claim 14 wherein the integer program further  
2 comprises storage constraints which ensure that a sum of the storage demands for  
3 each of the nodes does not exceed the storage capacity for the node.

1 16. (Original) The method of claim 2 wherein the integer program further  
2 comprises placement constraints which ensure that each of the services is placed  
3 on one and only one of the nodes.

1 17. (Original) The method of claim 2 wherein the services reside on the nodes  
2 according to a previous assignment.

1 18. (Original) The method of claim 17 further comprising the step of assessing  
2 reassignment penalties for service placements that differs from the previous  
3 assignment.

1 19. (Original) The method of claim 18 wherein the integer program further  
2 comprises a second objective that seeks to minimize the reassignment penalties.

1 20. (Previously Presented) A method of determining a placement of services of a  
2 distributed application onto nodes of a distributed resource infrastructure  
3 comprising the steps of:  
4 establishing an application model of the services that comprises processing  
5 demands for the services, storage demands for the services, and transport  
6 demands between the services;  
7 establishing an infrastructure model of the nodes that comprises processing  
8 capacities for the nodes, storage capacities for the nodes, and transport

9 capacities between the nodes;  
 10 forming an integer program that comprises:  
 11 a set of placement variables for a combination of the services and the  
 12 nodes, each of the placement variables indicating whether a particular  
 13 service is located on a particular node;  
 14 processing constraints which ensure that a sum of the processing  
 15 demands for each of the nodes does not exceed the processing capacity for  
 16 the node;  
 17 storage constraints which ensure that a sum of the storage demands for  
 18 each of the nodes does not exceed the storage capacity for the node;  
 19 placement constraints which ensure that each of the services is placed  
 20 on one and only one node;  
 21 communication constraints between node pairs which ensure that a  
 22 sum of the transport demands between a particular node pair does not  
 23 exceed the transport capacity between the particular node pair, each term  
 24 of the sum comprising a product of a first placement variable, a second  
 25 placement variable, and the transport demand between the services  
 26 associated with the first and second placement variables; and  
 27 an objective of minimizing communication traffic between the nodes  
 28 and balancing processing loads on the nodes; and  
 29 employing a local search solution to solve the integer program which  
 30 determines the placement of the services onto the nodes.

1 21. (Previously Presented) A computer readable memory comprising computer  
 2 code for directing a computer to make a determination of a placement of services  
 3 of a distributed application onto nodes of a distributed resource infrastructure, the  
 4 determination of the placement of the services onto the nodes comprising the steps  
 5 of:  
 6 forming communication constraints between node pairs which ensure that  
 7 a sum of transport demands between a particular node pair does not exceed a  
 8 transport capacity between the particular node pair, each term of the sum  
 9 comprising a product of a first placement variable, a second placement  
 10 variable, and the transport demand between the services associated with the  
 11 first and second placement variables;

12           forming an objective; and  
13           employing a local search solution to solve an integer program comprising  
14           the communication constraints and the objective, which determines the  
15           placement of the services onto the nodes.

1   22.   (Previously Presented) A computer readable memory comprising computer  
2           code for directing a computer to make a determination of a placement of services  
3           of a distributed application onto nodes of a distributed resource infrastructure, the  
4           determination of the placement of the services onto the nodes comprising the steps  
5           of:

6                 establishing an application model of the services comprising transport  
7                 demands between the services;

8                 establishing an infrastructure model of the nodes comprising transport  
9                 capacities between the nodes;

10                forming an integer program that comprises:

11                   a set of placement variables for a combination of the services and the  
12                   nodes, each of the placement variables indicating whether a particular  
13                   service is located on a particular node;

14                   communication constraints between node pairs which ensure that a  
15                   sum of the transport demands between a particular node pair does not  
16                   exceed the transport capacity between the particular node pair, each term  
17                   of the sum comprising a product of a first placement variable, a second  
18                   placement variable, and the transport demand between the services  
19                   associated with the first and second placement variables; and

20                   an objective; and

21                   employing a local search solution to solve the integer program which  
22                   determines the placement of the services onto the nodes.

1   23.   (Canceled)

1   24.   (Original) The computer readable memory of claim 22 wherein the objective  
2           comprises minimizing communication traffic between the nodes.

1   25.   (Original) The computer readable memory of claim 22 wherein the

2 application model further comprises processing demands for the services.

1 26. (Original) The computer readable memory of claim 25 wherein the  
2 infrastructure model further comprises processing capacities for the nodes.

1 27. (Original) The computer readable memory of claim 26 wherein the integer  
2 program further comprises processing constraints ensure that a sum of the  
3 processing demands for each of the nodes does not exceed the processing capacity  
4 for the node.

1 28. (Original) The computer readable memory of claim 27 wherein the objective  
2 comprises balancing the processing demands on the nodes.

1 29. (Original) The computer readable memory of claim 26 wherein the processing  
2 demands and the processing capacities are normalized according to a processing  
3 criterion.

1 30. (Original) The computer readable memory of claim 29 wherein the processing  
2 criterion comprises an algorithm speed.

1 31. (Currently Amended) The computer readable memory of claim 29 wherein  
2 the processing criterion comprises a transaction speed.

1 32. (Currently Amended) The computer readable memory of claim 29 wherein  
2 the processing capacities of the nodes are found according to a look-up table in  
3 which different types of nodes have been normalized according to the processing  
4 criterion.

1 33. (Original) The computer readable memory of claim 22 wherein the  
2 application model further comprises storage demands for the services.

1 34. (Original) The computer readable memory of claim 33 wherein the  
2 infrastructure model further comprises storage capacities for the nodes.

1 35. (Original) The computer readable memory of claim 34 wherein the integer  
2 program further comprises storage constraints which ensure that a sum of the  
3 storage demands for each of the nodes does not exceed the storage capacity for the  
4 node.

1 36. (Original) The computer readable memory of claim 22 wherein the integer  
2 program further comprises placement constraints which ensure that each of the  
3 services is placed on one and only one of the nodes.

1 37. (Original) The computer readable memory of claim 22 wherein the services  
2 reside on the nodes according to a previous assignment.

1 38. (Original) The computer readable memory of claim 37 further comprising the  
2 step of assessing reassignment penalties for service placements that differs from  
3 the previous assignment.

1 39. (Original) The computer readable memory of claim 38 wherein the integer  
2 program further comprises a second objective that seeks to minimize the  
3 reassignment penalties.

1 40. (Previously Presented) A computer readable memory comprising computer  
2 code for directing a computer to make a determination of a placement of services  
3 of a distributed application onto nodes of a distributed resource infrastructure, the  
4 determination of the placement of the services onto the nodes comprising the steps  
5 of:

6 establishing an application model of the services that comprises processing  
7 demands for the services, storage demands for the services, and transport  
8 demands between the services;

9 establishing an infrastructure model of the nodes that comprises processing  
10 capacities for the nodes, storage capacities for the nodes, and transport  
11 capacities between the nodes;

12 forming an integer program that comprises:

13 a set of placement variables for a combination of the services and the  
14 nodes, each of the placement variables indicating whether a particular

15 service is located on a particular node;  
16 processing constraints which ensure that a sum of the processing  
17 demands for each of the nodes does not exceed the processing capacity for  
18 the node;  
19 storage constraints which ensure that a sum of the storage demands for  
20 each of the nodes does not exceed the storage capacity for the node;  
21 placement constraints which ensure that each of the services is placed  
22 on one and only one node;  
23 communication constraints between node pairs which ensure that a  
24 sum of the transport demands between a particular node pair does not  
25 exceed the transport capacity between the particular node pair, each term  
26 of the sum comprising a product of a first placement variable, a second  
27 placement variable, and the transport demand between the services  
28 associated with the first and second placement variables; and  
29 an objective of minimizing communication traffic between the nodes  
30 and balancing processing loads on the nodes; and  
31 employing a local search solution to solve the integer program which  
32 determines the placement of the services onto the nodes.